

**SEWER SPECIFICATIONS**  
**S100**

**Rochester, MN**



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## **Section 1    GENERAL REQUIREMENTS**

### **S100.101   Description**

This work shall consist of the construction of pipe sewers utilizing plant-fabricated pipe and other appurtenant materials, installed for conveyance of sewage or storm water. The work includes construction of manhole and catch basin structures and other related items as specified.

The City of Rochester reserves the right, at any time during the construction of any sewer embraced within the limits of this contract, to issue a permit to a property owner to connect premises to the sewer. In the event such a permit is issued, the Contractor is not relieved of the responsibility to complete their contract according to Plans and Specifications. The issuance of a permit by the City to tap or connect to any part of a sewer embraced within the limits of this contract shall in no sense be construed as acceptance of any part of the work.

Use of the term "Plans, Specifications, and Special Provisions" within this specification shall be construed to mean those documents which compliment, modify, or clarify these specifications and are accepted as an enforceable component of the Contract or Contract Documents.

### **S100.102   Reference Documentation**

Provisions of the General Conditions and Trench Excavation & Backfill/Surface Restoration shall apply to this work. The Contractor shall abide by the applicable provisions of state, federal and local laws and ordinances.

All references to Mn/DOT Specifications shall mean the latest published edition of the Minnesota Department of Transportation Standard Specifications for Construction as modified by any Mn/DOT Supplemental Specifications issued before the date of advertisement for bids. All references to other Specifications of AASHTO, ASTM, ANSI, AWWA, etc. shall mean the latest published edition available on the date of advertisement for bids.

The following specifications have been referenced in this Specification:

ASTM A48	Specification for Gray Iron Castings
ASTM C76	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C270	Specification for Mortar for Unit Masonry
ASTM C361	Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C443	Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C478	Specification for Precast Reinforced Concrete Manhole Sections
ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D2241	Standard Practice for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D3034	Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3262	Specification for "Fiberglass" (Glass Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D4161	Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667	Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings
ASTM F679	Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F794	Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

ASTM F892	Specification for Polyethylene (PE) Corrugated Pipe With a Smooth Interior and Fittings
ASTM F949	Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
ASTM F1803	Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter
ANSI A21.4	Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings
ANSI A21.11	Standard for Rubber - Gasket Joints for Ductile Iron Pressure Pipe and Fittings
ANSI A21.51	Standard for Ductile Iron Pipe Centrifugally Cast
ANSI A21.53	Standard for Ductile-Iron Compact Fittings, 3 in. through 24 in

## **Section 2 MATERIALS**

### **S100.201 General**

All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade, and other details indicated in the Contract. Unless otherwise indicated, all required materials shall be furnished by the Contractor. If any options are provided for, as to type, grade, or design of the material, the choice shall be limited as may be stipulated in the Plans, Specifications, or Special Provisions.

All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Plans. Otherwise, the City may require advance approval of material suppliers, product design, or other unspecified details, as it deems desirable for maintaining adopted standards.

At the request of the Engineer, the Contractor shall submit in writing a list of materials and suppliers for approval. Suppliers shall submit a Certificate of Compliance that the materials furnished have been tested and are in compliance with the specifications. The Engineer may withhold payment, on appropriate items, pending submittal of the Certificate.

All pipe furnished for main sewer and service line installations shall be of the type, kind, size, and class indicated for each particular line segment as shown in the Plans and designated in the Contract Items. Wherever connection of dissimilar materials or designs is required, the method of joining and any special fittings employed shall be products specifically manufactured for this purpose and subject to approval by the Engineer.

### **S100.202 Alternate Pipe for Sanitary Sewer**

#### **A. 8 – 15-inch diameter.**

Sanitary sewers shall be constructed of the following materials unless otherwise specified:

1. Polyvinyl Chloride (PVC) Pipe ASTM D3034

#### **B. 18-inch diameter and larger.**

Sanitary sewers shall be constructed of the following materials unless otherwise specified:

1. Polyvinyl Chloride (PVC) Pipe ASTM F794
2. Polyvinyl Chloride (PVC) Pipe ASTM F949
3. Fiberglass Sewer Pipe ASTM D3262

#### **C. Close Proximity to Watermains.**

Sanitary sewers in close proximity to watermains shall be constructed of the following materials unless otherwise specified:

1. Ductile Iron Pipe AWWA C115
2. Polyvinyl Chloride (PVC) Pipe AWWA C900
3. Polyvinyl Chloride (PVC) Pipe ASTM 2241

### **S100.203 Ductile Iron Pipe and Ductile Iron Fittings**

The pipe furnished shall be Ductile Iron pipe and fittings furnished shall be of the Ductile Iron type as specified for each particular use of installation.

Ductile iron pipe shall conform to the requirements of AWWA C115 or C151 for water and thickness design shall conform to AWWA C150. In addition, the pipe shall comply with the following supplementary provisions:

1. Fittings shall conform to the requirements of AWWA C110 (Ductile iron Fittings) for the joint type specified.
2. Unless otherwise specified, all pipe and fittings shall be furnished with cement mortar lining meeting the requirements of AWWA C104 for standard thickness lining. All exterior surfaces of the pipe and fittings shall have an asphaltic coating at least one mil thick. Spotty or thin seal coating, or poor coating adhesion, shall be cause for rejection.
3. Rubber gasket joints for Ductile Iron Pressure Pipe and fittings shall conform to AWWA C111.

#### **S100.204 Reinforced Concrete Pipe and Fittings**

Reinforced concrete pipe, fittings and specials shall conform with the requirements of Mn/DOT Section 3236, ASTM C76 (Reinforced Concrete Pipe) (with rubber O-ring joints for the sanitary pipe), size, and strength class specified, subject to the following supplementary provisions:

1. All branch fittings such as tees wyes, etc. shall be cast as integral parts of the pipe. All fittings and specials shall be of the same strength class as the pipe to which they are attached. If the connections are fabricated in the field, the hole shall be cut with a tapping machine and an approved saddle installed.
2. When flexible watertight joints are specified, joints shall meet the requirements of ASTM C-361, with dimensions shown on Mn/DOT Standard Plate No. 3006G.
3. Lift holes will not be permitted in pipe smaller than 54" in diameter. The lift hole in pipe larger than 54" in diameter shall be filled with a commercially manufactured plug and a non-shrinking concrete grout.

#### **S100.205 Corrugated Steel Pipe and Fittings**

Corrugated steel pipe and fittings shall conform to the requirements of Mn/DOT Specification 3226 (Corrugated Steel Pipe) for the type, size and sheet thickness specified. The coupling bands shall cover at least two full corrugations on each side of the joint. When specifically provided for in the Plans Specifications and Special Provisions the galvanized steel pipe and fittings shall be furnished with special aramid fiber bonded, bituminous, or plastic coating or concrete lining as required.

#### **S100.206 Polyvinyl Chloride Pipe and Fittings**

Smooth walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM D-3034, ASTM 2241, AWWA C900, and ASTM F679 for the size, standard dimension ratio (SDR), and strength requirements indicated on the Plans, Specifications, and Special Provisions. The grade used shall be resistant to aggressive soils or corrosive substances in accordance with the requirements of ASTM D-543. Unless otherwise specified, all pipe and fittings shall be a minimum SDR 35 and connections shall be push-on with elastomeric gasketed joints which are bonded to the inner wall of the gasket recess of the bell socket.

Controlled inside diameter, (Closed or Open Profile) polyvinyl chloride pipe and fittings with smooth interior shall conform to the requirements of ASTM F-794 for the size and wall thickness indicated on the Plans, Specifications, and Special Provisions. Unless otherwise specified, all pipe and fittings shall be push-on with snug fit elastomeric joints meeting tightness requirements of ASTM 3212.

Corrugated polyvinyl chloride pipe and fittings with smooth interior shall conform to the requirements of ASTM F-949 for the size and wall thickness indicated on the Plans, Specifications, and Special



Provisions. Unless otherwise specified, all pipe and fittings shall be push-on with snug fit elastomeric joints meeting tightness requirements of ASTM 3212.

Polyvinyl Chloride (PVC) pipe shall be installed in conformance with the requirements of ASTM D-2321. Only class B embedment materials shall be used for PVC applications.

#### **S100.207 Dual Wall Corrugated Polyethylene Pipe**

Dual-Wall Corrugated Polyethylene Pipe shall conform to the requirements AASHTO M294 and Design 18 of the AASHTO Standard Specifications for Highway Bridges. The allowable storm sewer pipe sizes are 12-inch through 36-inch and must be located outside the roadway section. Joints shall be watertight unless the engineer approves a soil-tight joint. Pipe manufacture, watertight joint testing, and installation shall conform to current Mn/DOT requirements and/or as indicated in the Plans, Specifications, and Special Provisions.

#### **S100.208 Fiberglass Reinforced Polymer Mortar Pipe**

Fiberglass Reinforced Polymer Mortar Pipe shall conform to the requirements ASTM D-3262, ASTM D4161, and AWWA M45 for the size and strength requirements indicated on the Plans, Specifications, and Special Provisions.

### **S100.209 Metal Sewer Castings**

Metal castings for sewer structures such as manhole frames and covers, catch basin frame grates and curb boxes, shall conform to the requirements of ASTM A48 (Gray Iron Casting) subject to the following supplementary provisions:

1. Casting assemblies or dimensions, details, weights, and class shall be as indicated in detailed drawings for the design designation specified. Unless otherwise specified, the castings shall be Class 30 or better.
2. Lid-to-frame surfaces on round casting assemblies shall be machine milled to provide bearing around the entire circumference.
3. Casting weight shall be not less than 95 percent of theoretical weight for a unit cast to exact dimensions, based on 442 pounds per cubic foot.
4. A Certificate of Compliance shall be furnished with each shipment of castings stating the materials furnished have been tested and are in compliance with the specification requirements.
5. Unless otherwise specified, sanitary sewer manholes in areas subject to flooding by surface water shall have self-sealing, bolt-down, lids and recessed pick holes.

### **S100.210 Precast Concrete Manhole and Catch Basin Sections**

Precast concrete riser sections and appurtenant units (grade rings, top and base slabs, special sections, etc.) used in the construction of manhole and catch basin structures shall conform with the requirements of ASTM C-478, Mn/DOT 2506 and the following supplementary provisions:

1. The precast sections and appurtenant units shall conform to all requirements as shown on the detailed drawings.
2. Joints of manhole riser sections shall be tongue and groove with rubber "O" ring joints provided on sanitary sewer manholes. Sanitary sewer inlet and outlet pipes shall be joined to the manhole with a gasketed, flexible, watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place.
3. Air-entrained concrete shall be used in the production of all units. Air content shall be maintained within the range of 5 to 7 percent.
4. A Certificate of Compliance shall be furnished with each shipment of precast manhole and catch basin sections stating that the materials furnished have been tested and are in compliance with the specification requirements.
5. Lift holes will not be permitted in manhole sections smaller than 60" in diameter. On manholes 60" and larger diameter, the lift holes shall be filled with a commercially manufactured lift hole plug and non-shrink concrete grout. The concrete grout shall have an approved bonding agent added.

### **S100.211 Concrete**

Concrete for cast-in-place masonry construction shall be produced and furnished accordance with the requirements of Mn/DOT Specification 2461 for the mix designation indicated in the Plans. The requirements for Grade B concrete shall be met where a higher grade is not specified. Type 3 (air-entrained) concrete shall be furnished and used in all structures.

**S100.212 Mortar**

Mortar for use in masonry construction shall be an air-entrained mixture of one part Masonry cement, Type S, and 2.5 parts mortar sand, with sufficient water to produce proper consistency, and with sufficient air-entraining agent added to maintain an air content within the range of 7 to 10 percent. Mortar shall meet the requirements of ASTM C-270.

**S100.213 Trash Guard**

Trash guards, where shown on the plan shall have 5/8" (16mm) vertical galvanized steel rods placed 6" (150mm) center to center unless otherwise specified. The guard shall be securely attached to the end section.

**S100.214 Riprap**

Riprap, where shown on the plans, shall be constructed in accordance with Mn/DOT Section 2511.

## **Section 3 CONSTRUCTION REQUIREMENTS**

### **S100.301 Notification by Contractor**

#### **A. Sanitary Sewer Construction**

The discharge of surface water runoff or ground water into the city's sanitary sewer system is prohibited. To protect the sanitary sewers, authorized users, and the treatment works from the accidental discharge of surface water runoff or ground water into the active sanitary sewer the following procedure shall be followed:

1. Two weeks before connecting any new sewer piping to the existing sewer system, the contractor shall notify the Rochester Sewer Division of the Department of Public Works as to the schedule of sewer construction activities.
2. The Rochester Sewer Division will install a sewer plug in the outlet of the most downstream manhole through which no sewage is presently passing and that the new sewer will be connected. A plug will be install into each connection to the city's sewer system. In the event that the manhole into which the plug must be installed is a manhole constructed with this project, the Contractor shall notify the Rochester Sewer Division within 24 hours of the installation.
3. After the Rochester Sewer Division has installed the plug, the Contractor may proceed with the Installation of the sewer extension. Upon completion of the work including the cleaning of the sewer lines, air testing the sewer, and conducting the mandrel test, the Contractor shall notify the Rochester Sewer Division. Rochester Sewer Division will televise the public sewer mains. Once all the sewer extension passes all specified tests, the Rochester Sewer Division will remove the sewer plugs.
4. The sewer plugs will be installed by the Rochester Sewer Division and shall be removed by the Sewer Division. The Contractor shall not disturb the plugs.

### **S100.302 Installation of Pipe and Fittings**

#### **A. Inspection and Handling**

Proper and adequate implements, tools, and facilities satisfactory to the Engineer shall provided and used by the Contractor for the safe and convenient prosecution of the work. During the process of unloading, all pipe and accessories shall be inspected by the Contractor for damage. The Contractor shall notify the Engineer of all material found to have cracks, flaws or other defects. The Engineer shall inspect the damaged materials and have the right to reject any materials found to be unsatisfactory. The Contractor shall promptly remove all rejected material from the site. All materials shall be handled carefully, as will prevent damage to protective coatings, linings, and joint fillings; preclude contamination of interior areas; and avoid jolting contact, dropping, or dumping

All work and materials are subject to tests by the City at such frequency as may be determined by the Engineer.

While suspended and before being lowered into laying position, each pipe section and appurtenant unit shall be inspected by the Contractor to detect damage or unsound conditions that may need corrective action or be cause for rejection. The Contractor shall inform the Engineer of any defects discovered and the Engineer will prescribe the required corrective actions or order rejection.

Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.

#### **B. Pipe Laying Operations**

Trench excavation and bedding preparations shall proceed ahead of pipe placement as will permit proper laying and joining of the units at the prescribed grade and alignment without unnecessary deviation or hindrance.

All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are lowered into position in the trench and they shall be kept clean by approved means during and after laying. The sewer materials shall be carefully lowered into laying position by the use of suitable restraining devices. Under no circumstances shall the pipe be dropped into the trench.

At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than would be adequate to support the pipe throughout its length. No pipe material shall be laid in water or when the trench or bedding conditions are otherwise unsuitable or improper.

When placement or handling precautions in the Engineer's opinion prove inadequate, the Contractor shall provide and install suitable plugs or caps effectively closing the open ends of each pipe section before it is lowered into laying position, and they shall remain so covered until removal is necessary for the connection of an adjoining unit.

Unless otherwise permitted by the Engineer, bell and spigot pipe shall be laid with the bell ends facing upgrade and the laying shall start on the downgrade end and proceed upgrade. As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted by tamping around the pipe to a height of at least 12 inches above the top with hand operated mechanical tamping devices or by hand. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is effected. Backfill in the bell area shall be left loose

Connection of pipe to existing lines or previously constructed manholes or catch basins shall be accomplished as shown in the Plans or as otherwise approved by the City. Where necessary to make satisfactory closure or produce the required curvature, grade or alignment deflections at joints shall not exceed that which will assure tight joints and comply with any limitation recommended by the pipe manufacturer.

Entrance of foreign matter into pipeline openings shall be prevented at all times to the extent that suitable plugs or covering can be kept in place over the openings without interfering with the installation operations.

### **C. Connection and Assembly of Joints**

All pipe and fitting joints shall fit tightly and be fully closed. Spigot ends shall be marked as necessary to indicate the point of complete closure. All joints shall be soil tight, as the minimum requirement, and shall be watertight in all sanitary sewer lines. Where specified, the joints in certain assemblies shall be made structurally integral by being completely encased in concrete to form a rigid watertight unit as indicated in the standard drawings.

All joints shall be sealed as follows, subject to such other approved method as the City may authorize as being acceptable alternative:

1. Concrete pipe and fitting joints – compression type rubber gasket seals conforming to the requirements of ASTM C443, ASTM C-361 or AASHTO M-198 for circular pipe, or as otherwise approved by the Engineer in the case of non-circular pipe sections.
2. PVC pipe and fittings – assembled gasket seal joints.

3. Corrugated smooth wall PVC and corrugated double wall HDPE pipe and fittings – assembled push-on gasketed joints shall pass performance tests as listed in ASTM D-3212.
4. Corrugated steel pipe and fittings – sealed with Mn/DOT Standard Detail Plate M3221C.
5. Connections to storm sewer mains at other locations than manholes and catch basins shall be made with precast tees, wyes or junction boxes. Field cut openings may be permitted for mains, which are at least 2 times the size of the branch and no further than 100-ft from a structure. The materials, work and method of connection for other than precast connections shall be subject to the City's approval.

#### **D. Bulk heading Open Pipe Ends**

All pipe and fitting ends left open for future connection shall be bulk headed by approved methods prior to backfilling. Unless otherwise specified or approved, all openings of 24 inches diameter or less shall be closed off with prefabricated plugs or caps and all storm sewer openings larger than 24 inches in diameter shall be closed off with masonry bulkheads.

Prefabricated plugs and caps shall be of the same material as the pipe material, or an approved alternate material, and they shall be installed with watertight seal as required for the pipeline joints. Masonry bulkheads shall be constructed with concrete brick, or solid block to a wall thickness of 8 inches.

#### **S100.303 Appurtenance Installations**

Appurtenance items such as aprons, trash guards, gates and castings shall be installed where and as required by the Plans and in accordance with such standard detail drawings or supplementary requirements as may be specified.

Casting assemblies to be raised or lowered shall follow Mn/DOT Specification 2506.3 with the following modification: the structure construction (excluding casting) above the cone shall not exceed 1 foot.

When the plans call for reconstruction of structures, all debris shall be removed from the bottom of the old structure without additional compensation.

Sewer aprons shall be subject to all applicable requirements for installation of pipe. All aprons and outfall end sections shall be tied as per Mn/DOT Standard Plate 3145.

#### **S100.304 Sewer Service Installations**

Main sewer service connections and building service sewer pipe shall be installed as provided for in the Contract and as may be directed by the City. The sewer service connections and pipe lines shall be installed in conformance with all applicable requirements of the main sewer installation and as more specifically provided in the City of Rochester standard specification for the construction of service connections.

#### **S100.305 Sanitary Sewer Leakage Testing**

All sanitary sewer lines, including service connections, shall be substantially watertight and shall be tested for excessive leakage upon completion and before connections are made to the service by Others.

For gravity flow sewers, the sewer shall be subjected to exfiltration testing, by the ASTM F1417 (low pressure air) test method regardless of pipe material.

For sewers designated as pressure pipe sewers, the sewer shall be subjected to exfiltration testing, by the Minnesota Plumbing Code 4715.2820.

The requirements set forth for maximum leakage shall be met as a condition for acceptance of the sewer section represented by the test. All testing shall be performed by the Contractor without any direct

compensation being made therefore, and the Contractor shall furnish all necessary equipment and materials, including plugs as required.

### A. Air Test Method-Gravity Sewer

The Table below contains selected text from ASTM F1417 (Gravity Sewer Lines).

4.1 The section of the line to be tested is plugged. Air, at low pressure, is introduced into the plugged line. The line passes the test if the rate of air loss, as measured by pressure drop, does not exceed a specified amount in a specified time. Pressure drop may be determined by using Table 1 or Table 2, or calculated by use of the formulas in 9.2.

**TABLE 2 1 Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015**

NOTE-Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter.

Pipe Diameter, in.	Minimum Time, min : s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	28:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:18	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

9.2 Calculate all test times by the following formula:

$$T = 0.085 DK/Q$$

where:

T = shortest time allowed for the air pressure to drop 1.0 psig, s,

K = 0.000419 DL but not less than 1.0,

Q = leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF,

D = measured average inside diameter of sewer pipe (see Method D 2122 and Practice D 3567), in., and

L = length of test section, ft.

Table 1 contains the specified minimum times required for a 1.00 psig pressure drop from a starting pressure of 3.5 psig to a final pressure of 2.5 psig using a leakage rate of 0.0015 ft<sup>3</sup>/min/ft<sup>2</sup> of internal surface.

### B. Air Test Method-Pressure Pipe

The air test shall be made by attaching the air compressor or testing apparatus to any suitable opening and closing all other inlets and outlets to the system by means of proper testing plugs. Air shall be forced into the system until there is a uniform pressure of five (5) psi on the portion of the system being tested. The pressure shall remain constant for 15 minutes without the addition of air.

### C. Test Failure and Remedy

In the event of test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements. All repair work shall be subject to approval of the Engineer. Introduction of sealant substances by means of the test water will not be permitted.

Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance. All repair and replacement work shall be at the Contractor's expense.

### **S100.306 Deflection Test**

Deflection tests shall be performed on all plastic gravity sewer pipes. The test shall be conducted after the sewer trench has been backfilled to the desired finished grade for a minimum of 30 days.

The deflection test shall be performed by pulling a rigid ball or pointed mandrel through the pipe without the aid of mechanical pulling devices. The ball or mandrel shall have a minimum diameter equal to 92.5 % of the actual inside diameter of the pipe. The maximum allowable deflection shall not exceed 5 % of the pipe's internal diameter. The line will be considered acceptable if the mandrel can progress through the line without binding. The time of the test, method of testing, and the equipment to be used for the test shall be subject to the approval of the City.

All testing shall be performed by the Contractor at its expense without any direct compensation being made therefore, and he shall furnish all necessary equipment and materials required.

#### **A. Test Failure and Remedy**

In the event of test failure on any test section, the section shall be replaced, with all repair work subject to approval of the City. The replaced section shall be re-tested for leakage and deflection in conformance with the specifications contained herein. All repairs, replacement, and re-testing shall be at the Contractor's expense.

### **S100.307 Televising**

The city will televise all lines regardless of visual inspection, leakage testing, or deflection testing.



## **Section 4 METHOD OF MEASUREMENT**

### **S100.401 Description**

All items will be measured separately according to design designation as indicated in the Pay Item name and as may be detailed and defined in the Plans, Specifications, or Special Provisions. Pipe will generally be designated by size (inside diameter or span); strength class, kind or type, and laying condition. Complete-in-place items shall include all component parts thereof as described or required to complete the unit, but excluding any excesses covered by separate Pay Items. Linear measurement of piping will include the running length of any special fittings (tees, wyes, elbows, gates, etc.) installed within the line of measure between specified terminal points.

### **S100.402 Sewer Pipe**

Sewer pipe of each design designation will be measured by length along the line of pipe. Terminal points of measurement will be the pipe end at free outlets; the point of connection with in-place pipe; the center of manholes or catch basins; the point of centerline intersections at branch fittings; or the point of juncture with other appurtenances or units as defined.

Measurements for trench excavation will be determined separately, when included in the Pay Items for the Plans, and according to the Trench Excavation Specification.

### **S100.403 Manholes and Catch Basins**

Manholes and catch basins of each design will be measured by number of each constructed complete-in-place, including the base and castings as required, for the depth increments as stated in the proposal.

The depth of manholes and catch basins shall be considered as being the distance from the top of the ring, cover, or grate to the invert elevation at the center of the structure.

### **S100.404 Reconstruct Manholes and Catch Basins**

Reconstructed manholes and catch basins will be measured by height from the bottom of the reconstructed portion to the bottom of the ring or frame casting with no regard to type.

Connection of new catch basins to the existing storm sewer piping, including up to 1.5m (5 feet) of new pipe per location, and interconnection of multiple catch basins shall be considered an incidental expense.

### **S100.405 Adjust Frame and Ring Casting**

Adjust frame and ring casting will be measured by the number of castings adjusted, all the castings in any one structure being considered as one assembly.

### **S100.406 Outside Drop Connection**

Outside drop connections of each design will be measured by number of each constructed complete-in-place, including granular encasement, fittings, and any special piping as required, including two holes into existing manhole for the drop connection.

### **S100.407 Special Pipe Fittings**

Special pipe fittings (wyes, tees, bends, etc.) of each design designation will be measured by number of each installed complete-in-place as specified, but excluding any such fittings required to be installed as a component part of any other Work Unit.

**S100.408 Appurtenant Items**

Appurtenant items such as aprons, trash guards, gates and other prefabricated units or assemblies as identified by Pay Item name will be measured separately by number of each installed complete-in-place as specified.

## **Section 5   BASIS OF PAYMENT**

### **S100.501   General**

Payment for sewer pipe items at the Contract prices of each design shall be compensation in full for all costs of providing a complete-in-place pipeline, including excavation, foundation preparation, bedding, backfilling, leakage testing, plugging, restoration of surface improvements, disposal of surplus or waste materials, final cleanup, and such other work as may be specified, but excluding the construction or materials, specifically designated for payment under other Contract Items.

Payment for manhole, catch basin, outside drop connection, service connection, and other structures as specified, at the Contract prices per structure, shall be compensation in full for all costs of constructing each unit complete-in-place as specified, including all required castings, special fittings, base or encasement, and appurtenant materials as specified for the complete structure or section, but excluding such additional work as may be designated for payment under other Contract Items.

Special pipe fittings such as wyes, tees and bends will be paid for as separate Contract Items to the extent they are required to be installed in the sewer pipe and service pipe lines and not as a component part of a complete-in-place structure (risers, outside drop connections, service connections, etc.)

Appurtenant items such as aprons, trash guards, drainage gates, and other prefabricated units or assemblies and specials as designated will be paid for as separate Contract Items to the extent they are not included as a component part of any complete-in-place structure.

**S100.502 Items List**

Payment for construction of Sewer Main will be made on the basis of the following schedule:

ITEM NO	ITEM	UNIT
S100.513	Furnish & Install ___" Non-Reinforced Concrete Pipe, Class___	Linear Foot
S100.514	Furnish & Install ___" Reinforced Concrete Pipe, Class___	Linear Foot
S100.518	Furnish & Install ___" Corrugated Metal Pipe, ___ gauge (Specify Coating when Required)	Linear Foot
S100.519	Furnish & Install ___" Alternate Pipe Sewer	Linear Foot
S100.520	Furnish & Install ___" Alternate Pressure Pipe Sewer	Linear Foot
S100.522	Furnish & Install ___" Perforated ___ Pipe (Specify Type of Pipe)	Linear Foot
S100.524	Furnish & Install ___" Ductile Iron Pipe	Linear Foot
S100.530	Furnish & Install ___" x ___" Branch ___ (Specify Tee or Wye & Material)	Each
S100.532	Furnish & Install ___" Riser ___' to ___' High (Specify Height Range & Material)	Riser
S100.534	Furnish & Install ___" Bend ___ Degree Bend (Specify Degree & Material)	Bend
S100.536	Connect to Storm Sewer Main	Each
S100.540	Construct Manhole Type ___, ___' to ___' Deep	Structure
S100.548	Construct Junction Box ___' to ___' Deep	Structure
S100.550	Construct Catch Basin Type ___, ___' to ___' Deep	Structure
S100.552	Construct Double Catch Basin Type ___, ___' to ___' Deep	Structure
S100.560	Remove ___	Each
S100.562	Remove ___	Linear Foot
S100.563	Remove & Salvage ___	Each
S100.564	Remove & Salvage ___	Linear Foot
S100.565	Remove and Reinstall ___	Linear Foot
S100.566	Reconstruct ___	Each
S100.568	Reconstruct ___	Linear Foot
S100.570	Connect into Existing	Each
S100.572	Adjust	Structure
S100.574	Adjust	Assembly
S100.576	Modify	Each
S100.578	Furnish & Install	Each